

**Graduate Comprehensive Exam: Artificial Intelligence (Spring 2004)**

Answer all questions on the exam. You may use the back for additional space. Total: 100 points. Good Luck.

1. (20 pts) Consider the the following algorithms:

- (a) A\*
- (b) DFS (depth-first search)
- (c) BFS (breadth-first search)
- (d) Greedy Search
- (e) Iterative Deepening

The questions are:

- (a) Which are guaranteed to find the optimal path?
  - (b) Justify your answer to (a) using an example problem.
2. (15 pts) Describe the concepts of admissible and dominant heuristic functions for A\*. Give an example for each concept.
3. (10 pts) What is the difference between propositional logic and first order logic?
4. (10 pts) Which of the following inference techniques are refutation complete for general first order logic knowledge bases:
- (a) modus ponens
  - (b) resolution

Give the logic expression of the above two inference rules.

5. (15 pts) What are the meaning of alpha and beta in Alpha-Beta algorithm for game playing? How should they be initialized?
6. (10 pts) Which of the following are horn rules:
- (a)  $A \vee B$
  - (b)  $A \Rightarrow B$
  - (c)  $A \wedge \neg B \Rightarrow C$
  - (d)  $A \wedge B$
  - (e)  $A \wedge B \Rightarrow C \vee D$
  - (f)  $A \vee B \Rightarrow C \wedge D$

7. (20 pts) Given the following data, consider a decision-tree learning algorithm to learn if the stock market will go up or not. All attributes: GDP, CPI, and UR, could be up, unchanged, or down.

Gross Domestic Product (GDP)	Consumer Price Index (CPI)	Unemployment Rate (UR)	Stock Market is Up
up	unchanged	down	yes
up	down	up	no
up	up	down	yes
unchanged	down	down	no

- (a) What is in the first decision node, if any, and why?
- (b) What is in the second decision node, if any, and why?
- (c) If learning stops after steps (a) and (b), draw the learned tree.
- (d) Does the tree in (c) correctly classified all examples in the above data set?